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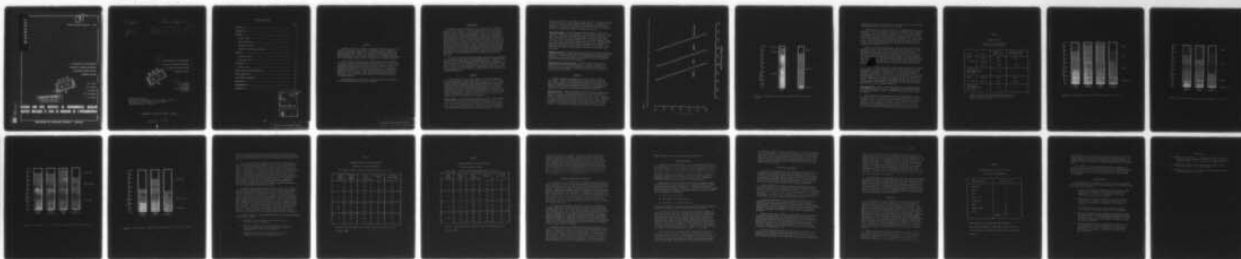
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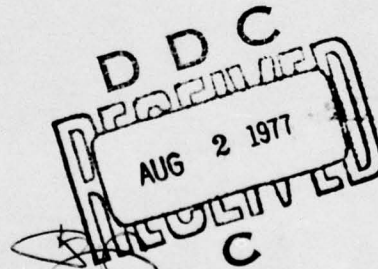
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DCIEM Technical Report No. 77X17

AN EVALUATION OF THE PHYSICAL
TRAINING OF OFFICER CANDIDATES
AT CANADIAN FORCES OFFICER
CANDIDATE SCHOOL



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ABSTRACT

DCIEM was tasked to examine the physical training aspects of the syllabus at Canadian Forces Officer Candidate School. Changes in aerobic power, body composition, muscular strength and flexibility were monitored for 2 courses, one direct entry candidates and one with commissioned from the ranks candidates. The incidence of injury and lost training times was also monitored with a special register.

All candidates, especially the younger direct entry personnel arrived on course with higher than anticipated levels of fitness and consequently showed small improvements during training. There were significant changes in body composition with smaller changes in strength and flexibility. The relative influence of the scheduled physical activities and the field exercises on these changes are discussed. The incidence of sick parade attendance and consequent time lost from training is small (about 1%) and probably cannot be further reduced.

Recommendations to achieve greater efficiency and utilization of time and existing resources are included.

INTRODUCTION

DCIEM was tasked by Canadian Forces Training System (CFTS) to examine certain aspects of the basic training courses for officer candidates and recruits to the Canadian Forces. This report deals with two courses of officer candidates at Canadian Forces Officer Candidate School (CFOCS) CFB Chilliwack. The trainees in CFOCS 7609 comprised 46 direct entry officers (DEO) with the addition of 14 candidates from other countries, who will be referred to in this report as foreign nationals. The trainees in CFOCS 7610, which ran almost concurrently with 7609, were 71 experienced CF personnel who had been selected for officer training. These personnel, who will be referred to collectively as commissioned from the ranks, (CFR), are generally older than the DEO trainees, and of course have the benefit of previous military experience. The CFR course was somewhat shorter with less emphasis on the physical nature of the training.

This report examines the conditioning response of the candidates to the CFOCS training syllabus from several aspects: aerobic power, changes in body composition, muscular strength and flexibility, compliance with the requirements of CFAO 50-1 and sick parade attendance. Some of the interrelationships are discussed and conclusions are drawn from the data presented. Recommendations for changes in certain aspects of the training are included for consideration by the appropriate agencies.

METHODS

The personnel tested in this study were officer candidates attending two CFOCS courses, 7609 and 7610, from Sept to Dec 1976. Course 7609 included young direct entry candidates from Canada and foreign national candidates from Caribbean and African countries. Forty-six direct entry candidates and fourteen foreign national candidates, all males, were tested at the beginning, during the third week and at the end of the course (initial, interim and final tests, respectively). Course 7610, composed of CFR personnel comprising seventy-one men and one woman, was tested twice, at the beginning and at the completion of training.

Aerobic Power - Aerobic power (VO_2 max) was predicted from submaximal exercise performed using the MONARK bicycle ergometer. The total work period lasted ten minutes at a pedalling speed of 50 rpm. The first five minutes at a workload of 600 kpm/min allowed the subject to warmup after which a second five minute workload (usually 1200-1500 kpm/min) was selected to produce a heart rate

which was about 85% of maximum predicted from age. Heart rate during the final minute, recorded using a Cambridge ECG, and workload, was used to predict VO_2 max according to the nomogram of Astrand and Rhyming⁽¹⁾. Individuals were classified into one of four categories of VO_2 max proposed by Cooper⁽²⁾ and shown in Figure 1.

Body Composition - Skinfold thickness was measured at three sites (triceps, subscapular and suprailiac) using Harpenden calipers. These measurements provide an estimate of body fat content since about 50% of body fat is located subcutaneously. A total for the three sites of 35 mm is considered "ideal" for a young male whereas 50 mm is a value above which he can be described as obese. Skinfold thickness measurements can also be used to calculate percent body fat using the equations of Durnin (1973) and Brozek et al (1963). Lean body mass is obtained by subtracting the weight of body fat from body weight.

Pulmonary Function - Forced vital capacity (FVC) and forced expiratory volume (FEV_1) was measured using the Monaghan M403 pulmonary function analyser. Values for FVC which are at least 90% of that predicted from height and age and ratios of $\text{FEV}_1/\text{FVC} \times 100$ which are greater than 70% indicate normal lung function.

Flexibility and Muscle Strength - Hip and trunk flexibility were measured using the Leighton flexometer. Hand grip strength was measured by the Stoelting hand dynamometer, while other indirect tests of muscle strength, as specified in CFAO 50-1, were carried out by the B per O staff.

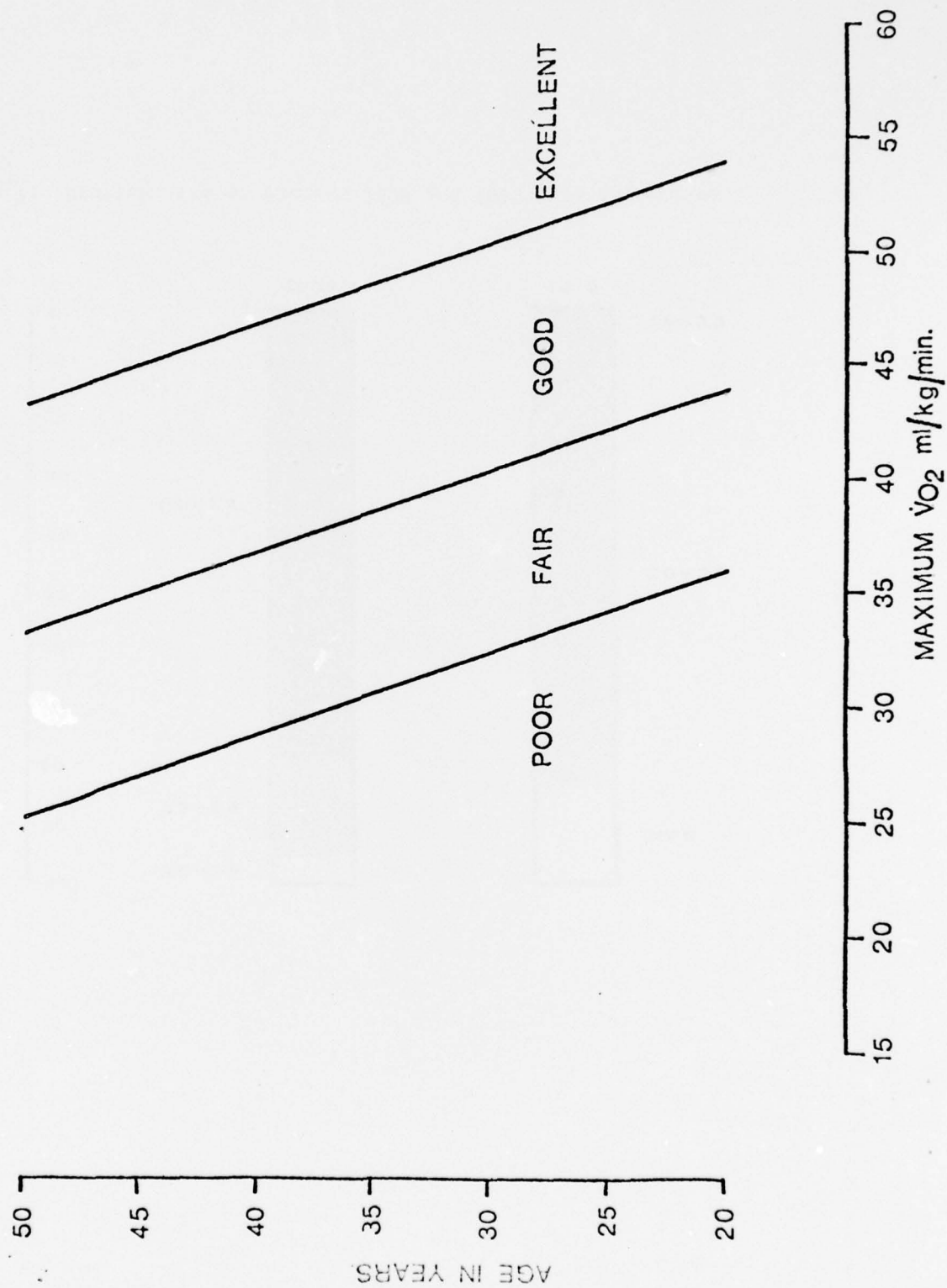
RESULTS

Figure 2 compares candidates from courses 7609 and 7610 by age. Whereas 78% of the candidates on course 7609 were aged 18 to 24 years, 76% of 7610 were between 30 and 39. The data in this study can therefore be compared with values for CF personnel aged 18-24 and 30-39 tested on previous occasions and considered to represent the average for the Canadian military population.

Aerobic Fitness - Table 1 shows mean values for VO_2 max and running time for 1.5 mile. Although candidates on course 7609 increased their VO_2 max by an average of 8% during the first three weeks, no further improvement was observed at the end of the course. Candidates on 7610, tested at the beginning and the end of the course, showed no significant change in VO_2 max. On the other hand, both courses were able to significantly reduce their time to run the 1.5 mile distance. Table 1 also contains data for other CF personnel of

FIGURE 1:

Categories of aerobic power based on standards of Cooper for age 25 and using Astrand age correction.



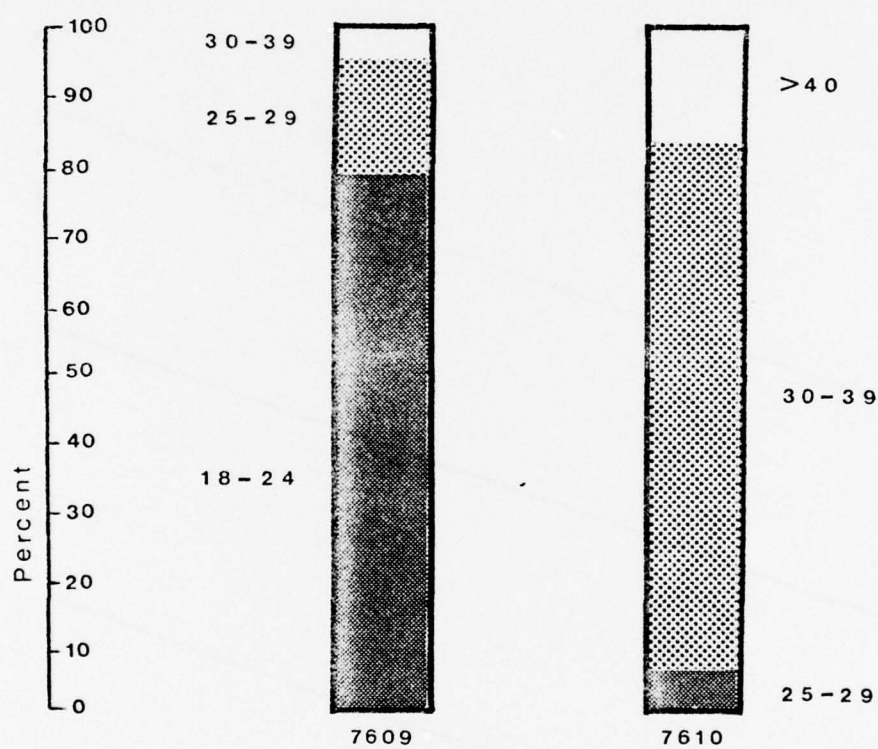


Figure 2: Distribution of courses 7609 and 7610 into categories by age.

comparable age and it is evident that the candidates of both 7609 and 7610 achieved above average levels of VO_2 max.

Figure 3 shows the percentage of course 7609 candidates in each category of poor, fair, good or excellent, according to the standards in Figure 1, and corresponding to levels 2, 3, 4 and 5 respectively. Also included in Figure 3 is a similar treatment of data from 360 other CF personnel aged 18-24 years. At the beginning of the course, 77% of the candidates tested had achieved levels 4 or 5. After three weeks, and until graduation, 95% had achieved and maintained these levels. Among other CF personnel of the same age, only 54% were categorized as level 4 or 5.

Figure 4 shows the distribution of VO_2 max into the four categories for course 7610 and for 554 CF personnel aged 30-39. At the beginning of the course, 76% were rated as level 4 or 5 with a decrease to 66% at graduation. By contrast, only 43% of other similar age CF personnel had achieved these levels of aerobic fitness. If level 5 alone is considered the percentages at the beginning of each course were 33% and 15% for 7609 and 7610 respectively, compared with 52% and 17% at graduation. By comparison, the proportion of other CF personnel in the excellent category was 19% for age 18-24 and 4% for age 30-39.

Categories of VO_2 max can be compared with performance in running the 1.5 mile. At the beginning of course 7609, 61% and 35% of the candidates were rated as level 5 and 4, respectively, according to standards in CFAO 50-1. At the end of the course 7609, 81% were rated as level 5 and 19% as level 4. At the beginning of course 7610, the percentage rated as level 5 and 4 were 37% and 56%, respectively, and this improved to 57% and 43%, respectively, by the end of the course. Both courses showed an improvement during the training and, at graduation, all candidates were able to meet the minimum requirement for the 1.5 mile distance (level 4).

Body Composition - Table 2 shows mean values for skinfold thickness, body weight and lean body mass. Candidates on course 7609 showed an average decrease of 5 mm in skinfold thickness indicating a loss of body fat.

Since there was no significant change in body weight, this represents a gain of 1.6 kg. in lean body mass, presumably an increase in muscle tissue. Candidates on course 7610 showed an average decrease of 9 mm in skinfold thickness. Again since body weight was unchanged, this represents a loss of fat and a gain of 1.8 kg in lean body mass, presumably reflecting an increase in muscle tissue. Table 2 also contains skinfold thickness data for CF personnel of

TABLE 1

AEROBIC FITNESS

Comparison of 7609 and 7610
with other CF personnel

Course	Test	VO ₂ max (ml/kg. min)	Running time for 1.5 mile (min)
7609 (n = 60)	initial	48.7	10.1
	interim	52.7*	-
	final	53.2*	9.6*
CF Personnel aged 18-24 years (n = 369)		44.1	-
7610 (n = 72)	initial	40.6	11.1
	final	40.9	10.5*
CF Personnel aged 30-39 years (n = 554)		34.5	-

Values are means. Significant differences from the initial measurement by paired t-test ($p < 0.01$) are indicated by an asterisk.

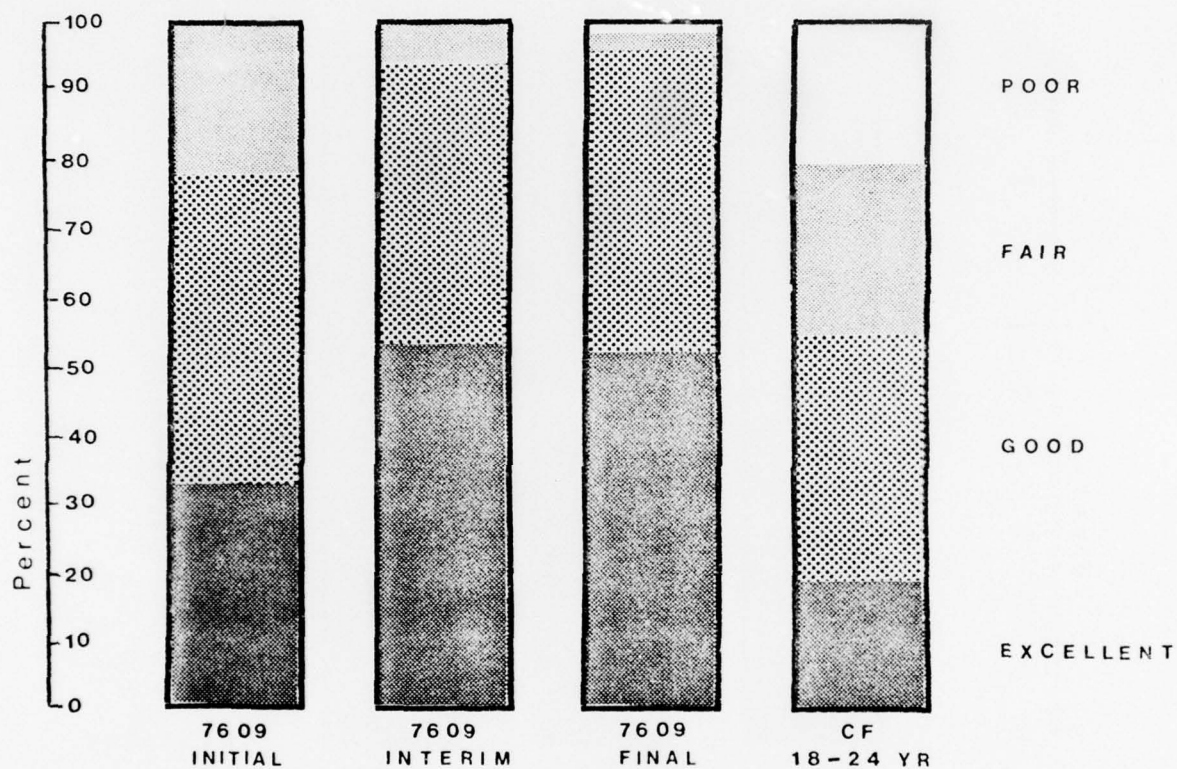


Figure 3: Distribution of course 7609 into categories of VO_2 max.

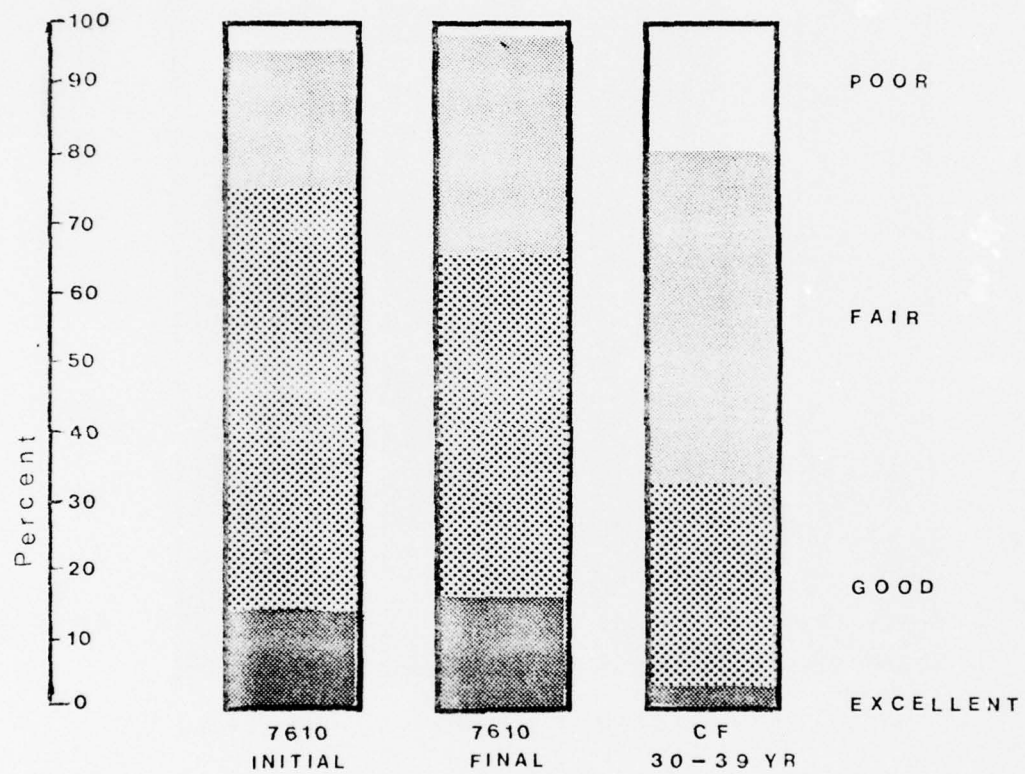


Figure 4: Distribution of course 7610 into categories of VO_2 max.

TABLE 2

BODY COMPOSITION

Comparison of 7609 and 7610
with other CF personnel

Course	Test	Sum of three Skinfolds (mm)	Body weight (kg)	Lean body mass (kg)
7609	initial	35.5	72.2	56.9
	interim	35.4	72.1	56.9
	final	30.6*	72.7	58.5*
CF Personnel aged 18-24 years (n = 327)		46.4	-	-
7610	initial	50.3	76.5	57.3
	final	41.5*	76.6	59.1*
CF Personnel aged 30-39 years (n = 556)		53.2	-	-

Values are means. Significant differences from the initial measurement by paired t-test ($p < 0.01$) are indicated by an asterisk.

comparable age. Candidates on course 7609 carried much less fat than others at the same age in the CF and 7610, while not very different at the beginning of the course, graduated with an average skinfold thickness which was markedly less than the average for the CF.

The sum of three skinfold thickness measurements for course 7609 are categorized in Figure 5 as less than 35 mm (lean), 35-50 mm (acceptable) or greater than 50 mm (too much body fat). Also included is a similar treatment of data for 327 other CF personnel aged 18-24 years. At the beginning of the course 7609 only 12% of the candidates had total skinfold thickness greater than 50 mm and this proportion declined to 5% at graduation. By comparison, among other CF personnel of the same age the percentage was 19%. Figure 6 shows the distribution into the same three categories for course 7610. Although 46% of the candidates had a total skinfold thickness in excess of 50 mm at the beginning, the percentage declined to 24% at graduation. By contrast, other CF personnel of comparable age showed 52% with total skinfold thickness greater than 50 mm.

DISCUSSION

Aerobic Power - The principle aim of this study was to examine the effects of the CFOCS training syllabus on the trainees with additional attention to changes in fitness and the accompanying incidence of injuries and complaints resulting in a loss of training. The response to training involves many changes including increases in aerobic power, gains in muscular strength and alterations in body composition, all of which may be regarded as the training effect. In the context of CFOCS training, this derives from both scheduled physical training activities and the field exercises which are an important component of the courses. While it was anticipated that some benefit would accrue from the field exercises, improvement in fitness levels is not a major objective; the teaching of military skills and the application of stress through fatigue and hard work being paramount considerations.

Nevertheless, it is possible to assess the potential aerobic training effect of an exercise by considering the energy cost. The only field activity which lends itself to assessment with regard to training for aerobic fitness is walking with and without loads on level and uphill terrain (in the Chilliwack area this is largely over gravel roads). Tables 3 and 4 show the energy cost of this activity expressed as a percent of $\dot{V}O_2$ max. For exercise lasting 1-2 hours, an intensity which is 60% of $\dot{V}O_2$ max should produce some improvement in aerobic fitness. It is apparent that for personnel in the good (level 4) category, carrying a 40 lb pack at

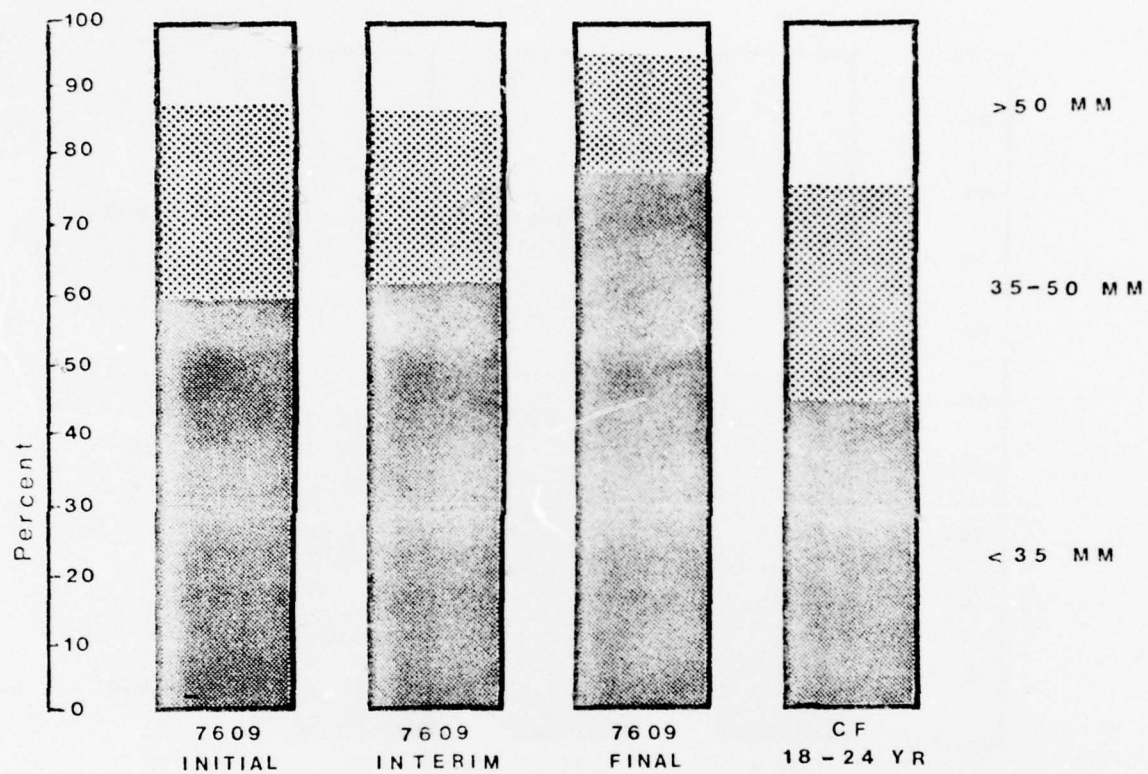


Figure 5: Distribution of course 7609 into categories of skinfold thickness.

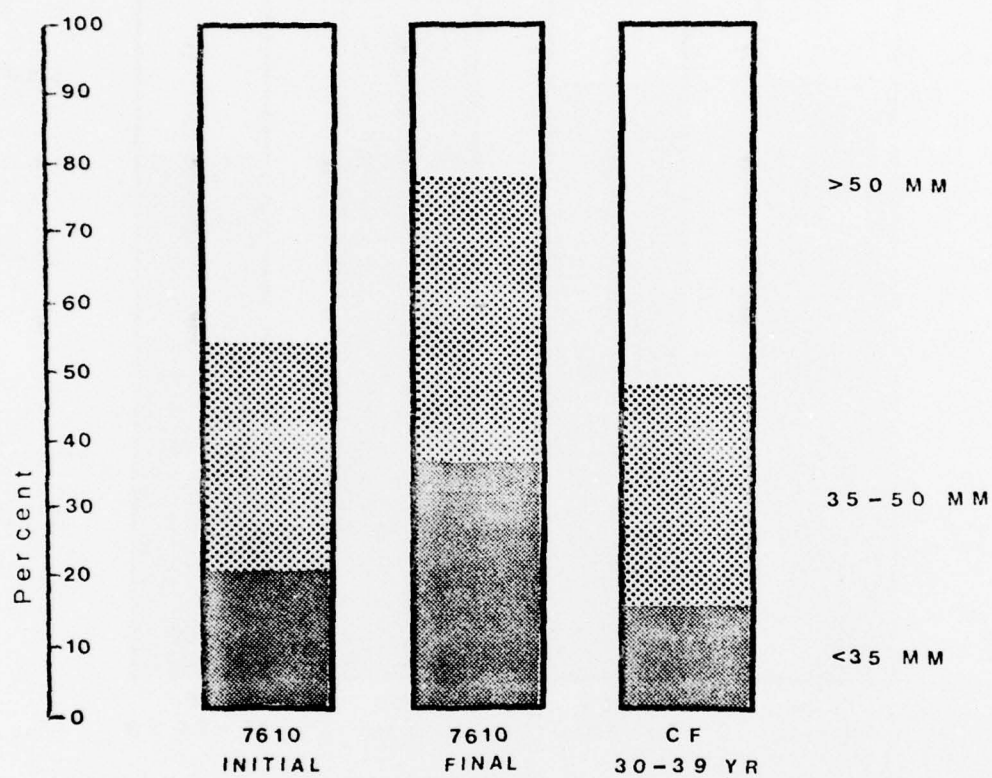


Figure 6: Distribution of course 7610 into categories of skinfold thickness.

4.0 mph will produce the required training effect. Tables 3 and 4 provide guidelines whereby times, distance and terrain can be selected to ensure that field exercises produce an improvement in aerobic fitness.

Most of the aerobic training effect from the scheduled physical education classes and early morning runs occurred in the first few weeks. Our interim report (after 3 weeks on course) showed significant improvements in aerobic power, particularly for those candidates at the lower end of the range, with no significant change thereafter. This non-linear response was not unexpected; the greatest rate of improvement normally occurs early in any training regimen. However, the lack of significant change after 3 weeks indicates that an increased stimulus at this point was necessary to continue the improvement. It must also be remembered that these candidates, particularly the DEO personnel, were exhibiting a high level of fitness after 3 weeks and further improvement would have required a much greater investment of time and effort.

To achieve the maximum gain from time and effort, the design of any program to improve aerobic fitness should consider the initial fitness level, the desired level and the appropriate weighting of duration, intensity and frequency of exercise. Having determined a safe initial activity level, the parameters of duration, intensity and frequency can be adjusted as desired to maintain a stimulus and prevent the development of a fitness plateau. With respect to the CFOCS program, the early morning run of 1.5 miles has proved effective. However, as proficiency increases the length of time at which the heart rate is sufficiently elevated to provide a training stimulus decreases. Typically, if the run is completed in 12 minutes or less, the training stimulus will apply for only the last 5 to 8 minutes. A longer distance, say 3 miles, will provide a stimulus for about 20-25 minutes, if the elapsed time is 30 minutes (level 4).

A sample program for CFOCS candidates might include the following progression of events:

- a) introduce a daily walk/run of 1.5 miles with no specified time for completion.
- b) when all candidates can cover this distance in less than 15 minutes, increase the distance to 3 miles of jogging with a target time of 35 minutes.
- c) gradually reduce the time allotted to 30 minutes (level 4) and finally 25 minutes (level 5).

TABLE 3

TRAINING EFFECT OF WALKING WITH AND
WITHOUT LOADS (LEVEL TERRAIN)

Body weight = 160 lb; terrain factor for gravel road = 1.1

Load weight (lbs)	Walking speed (mph)	Energy cost (kcal/hr)	% VO_2 max (good)	% VO_2 max (excellent)
0	3.0	321	27	23
	3.5	400	35	29
	4.0	489	53	44
25	3.0	358	39	32
	3.5	449	48	40
	4.0	552	59	49
40	3.0	385	41	34
	3.5	485	52	43
	4.0	595	64	53
50	3.0	406	44	36
	3.5	509	55	45
	4.0	626	67	56

VO_2 max = 51.6 ml/kg/min for excellent and 42.6 ml/kg/min for good

(Cooper, 1968)

TABLE 4
 TRAINING EFFECT OF WALKING WITH AND
 WITHOUT LOADS (5% GRADE)

Body weight = 160 lb; terrain factor for gravel road = 1.1

Load weight (lbs)	Walking speed (mph)	Energy cost (kcal/hr)	% VO ₂ max (good)	% VO ₂ max (excellent)
0	2.5	412	44	37
	3.0	507	55	45
	3.5	618	67	55
25	2.5	463	50	41
	3.0	573	62	51
	3.5	701	76	62
40	2.5	498	54	44
	3.0	617	66	55
	3.5	756	81	67
50	2.5	524	56	47
	3.0	650	70	58
	3.5	796	86	71

VO₂ max = 51.6 ml/kg/min for excellent and 42.6 ml/kg/min for good
 (Cooper, 1968)

The guiding principle throughout should be a gradual increase of activity and energy expenditure. Near maximum effort should be avoided, especially for the CFR personnel, until near the end of the course when adequate conditioning will have occurred to render such attempts safe; and then only as a means of assessing fitness. The graded approach to aerobic conditioning, aside from reducing the risk of an unfortunate cardiac event will also reduce the incidence of trauma of muscle and ligament injury. It is worth noting that the 1.5 mile run was introduced into the CF as a test of aerobic fitness and it was never intended that this distance should be regarded as an adequate training stimulus.

MUSCULAR STRENGTH AND FLEXIBILITY

The increase in lean body mass, presumably muscular development, suggests that an increase in muscular strength should have occurred during the training period. The only direct measurement was handgrip strength which showed a small but significant increase for both groups. Indirect measurements (sit-ups, chin-ups and vertical jumps) were administered by the BPERO staff to candidates on both courses. While some improvement was evident, it is difficult to quantify since the candidates were expected to meet the CFAO 50-1 standards and were not required to put forth a maximum effort except where this was necessary to meet the standard. Although 28 out of 76 were unable to meet the chin-up requirements initially, all but three were successful in the final test.

The reported difficulties with some aspects of the confidence course, notably the overhead rope traverse and the wall climbs were attributed to insufficient upper body strength. Since nearly all of the candidates were able to meet the CF standards for chin-up during the final testing period, it may be necessary to rationalize the current standards and the military skills requirements. Inadequate upper body strength is sometimes accompanied by back problems when strenuous activity is undertaken. The absence of reported back problems in the MIR sick parade register does not support the contention that this is a limiting factor in the severity of physical training stress currently applied at CFOCS.

Although there are no flexibility standards applicable to the CFOCS training, DCIEM conducted two trunk and hip flexibility measurements on all candidates on each testing occasion. Both measurements showed a significant improvement in both groups. The improvement was evident at 3 weeks (interim test 7609) with no further change at the final test. While there is no evidence to suggest that this early improvement in flexibility is related to the low incidence of back problems, the emphasis on conditioning in the early phases of

CFOCS training syllabus would certainly be beneficial.

BODY COMPOSITION

Changes in body weight are not always an accurate reflection of body composition. While an increase in body weight usually reflects an imbalance between caloric intake and energy expenditure, it may not mean an increase in the proportion of fat to lean tissue. In the same vein, response to a program of exercise frequently reduces the proportion of fat with no change in total body weight. Indeed, a frequently heard complaint about no weight loss after a few weeks of exercise indicates the lack of understanding of the changing relationships of the major components of body composition.

Measurement of skinfold thickness provides a reliable estimate of total body fat and is therefore a more useful indication of body composition than changes in body weight. Criteria for the sum of three skinfold measurements (Σ 3SKF) used by DCIEM are those recommended by the International Biological Program 1968 and used in Fig. 5 where three categories are recognized:

- a) lean - less than 35 mm,
- b) acceptable - 35 to 50 mm, and
- c) unacceptable - greater than 50 mm.

Of greatest concern is the third category where the risk to health is considered to increase as the skinfold thickness increases.

The initial differences, evident in mean values for Σ 3SKF for 7609 (35.5 mm) and 7610 (50.3 mm) represent the usual increase with age. In both cases there is a significant decrease at the end of training with no change in body weight, indicating an increase in lean body mass. These values contrast sharply with similar data accumulated by DCIEM from other CF personnel in the same age ranges (Table 2). For both age groups, the CFOCS candidates, even before training, demonstrated less body fat. Whether this is the result of the selection process within the CF or represents a natural selection on the part of current prospective candidates is not known.

The changes in body composition are especially interesting in relation to the overall physical intensity and resulting energy expenditure by the trainees. Although there were a few complaints of not enough time to eat, most of the candidates commented on their increased food consumption while on course. This was particularly true for 7610 (CFR) candidates, many of whom had become conscious

of increasing weight and were restricting their caloric intake prior to arrival at CFOCS. The significant reduction in skinfold thickness coupled with an augmented food intake suggests a particularly sedentary lifestyle before selection for training at CFOCS. This observation was confirmed through individual discussions with members of the course, many of whom ruefully admitted to not having worked so hard for years.

SICK PARADE ATTENDANCE

One of the original aims of the study was to ascertain the relationship, if any, between the level of physical fitness, the frequency and the type of injury and the progression of the course. At the request of DCIEM, the base medical clinic set up a special sick parade register (CF 2100) which was used to record all visits to the clinic by members of CFOCS 7609 and 7610. A total of 238 entries are listed between 30 September and 8 December 1976.

After exclusion of the data for the foreign nationals there were 104 visits to the clinic by 45 candidates. Of these visits, 76 were "initial" visits occasioned by a specific injury or complaint while 28 were follow-up visits. There were 6 admissions to hospital accounting for 17 days and the "light duty" disposition accounted for 94 man-days. The "light duty" involved excusal from participation in the field exercises and physical training sessions.

A further sub-division of the 76 initial visits disclosed 24 which were considered to be purely "medical" and unrelated to participation in the physical aspects of the course in instruction. The remaining 52 initial visits are assumed to have been more directly related to the physical demands of the course and in this sense, could be considered "preventable". Table 5 lists the anatomical location.

To what extent these injuries or trauma were truly preventable is difficult to determine. It can be speculated that, had the reporting individual possessed a higher level of physical fitness, many of these injuries would not have occurred. In some cases, this is probably true as e.g. the examining physician describes the patient as being "too fat" whereas in other cases the problem is "blisters" resulting from ill-fitting footwear and not attributable to physical conditioning per se.

It has also been suggested that many of these problems could be avoided if the candidates were better prepared for the rigors of field exercises during the early part of the course. This may have some validity since many of the complaints occur during or immediately

after the field exercises. Whether additional time should be programmed early in the course to accommodate this will depend on the several other time demands and objectives of the training staff. The ratio of MIR visits to candidates on course (foreign nationals excluded) is $117/114 = 1.1$ for 7609 and 7610 combined, compares with a ratio of 1.8 and 2.6 recorded for 2 courses in 1975.⁽³⁾ So long as one of the objectives of the course is to provide a stressful situation in a military environment where chronic fatigue and "pressure" are intentional, some injuries and trauma are almost inevitable. Slipping from a rock and turning an ankle will not necessarily be prevented by more physical preparation although the likelihood of severe injury is reduced.

It is probably also inevitable that there will be some voluntary withdrawals occasioned by the physical nature of the training. These losses are not fully accounted for above since some may have withdrawn before appearing in the sick parade register. Analysis of the initial physiological testing data and subsequent withdrawals does not reveal any correlation suggesting that attitude and other psychological considerations as well as physical capacity, or the lack of it, is an important factor in determining whether an individual will persevere and graduate from the course.

CONCLUSION

It is apparent that the candidates on CFOCS courses 7609 and 7610, upon arrival at CFOCS, possessed above average levels of aerobic fitness compared to other CF personnel of comparable age. Personnel on 7609 achieved a further improvement after three weeks which was maintained throughout the remainder of the course. Personnel on 7610 showed no improvement during the course although they were able to reduce the time to run the 1.5 mile distance. These findings indicate that the scheduled physical conditioning activities are effective in the early part of the course for the DEO (7609) candidates. If it is desired to continue the improvement throughout the remainder of the training it will be necessary to increase the time and effort devoted to this phase of the training. The reduced level of physical activity scheduled for the CFR (7610) candidates is not sufficient to provide a significant training effect for the group although many individuals did achieve an increase in aerobic fitness.

Changes in flexibility, body composition and muscle strength were evident for personnel from both courses. With the exception of indirect measurements of strength (push-ups etc.), there are no applicable standards in the CF. For those in the combat arms specialties there may be a requirement for a higher level of mus-

TABLE 5
ANATOMICAL DISTRIBUTION AND FREQUENCY
OF INJURIES OR COMPLAINTS

Anatomical Site	Number of Visits
Shoulder	1
Thorax	1
Back	1
Upper Leg	1
Lower Leg	6
Knee	11
Ankle & Heel	16
Foot	15
	<hr/>
	TOTAL 52

92% of the visits involve the lower extremity.

The reported weakness in upper body and back strength is not reflected in complaints involving the upper body or back.

cular strength. The DCIEM criteria for skinfold thickness have been accepted but have not been promulgated by the Surgeon General. All of the changes indicated are considered to be beneficial and each candidate should be encouraged to maintain these levels of accomplishment.

The incidence of sick parade visits and the resulting lost training time is approximately one percent of the scheduled syllabus. This is notably less than the incidence reported earlier and probably represents a minimum when the physical nature of the course is considered.

RECOMMENDATIONS

The following recommendations are offered with the realization that the overall objectives and time constraints of the CFOCS syllabus may necessitate compromises.

1. Liaison and consultation between the BPERO staff and CFOCS training staff should be used to greater advantage in planning and implementing the physical training and conditioning aspects of the syllabus.
2. Subject to (1) the early morning exercise period should be modified to gradually increase the duration of the exercise to approximately 30 minutes and a distance of 3 miles.
3. As a corollary to (2) the 1.5 mile distance should be used only for its original purpose as a test procedure.
4. So far as is possible, the conditioning activities should be progressive and continuous without interruptions longer than 2 or 3 days. Long interruptions followed by a period of intensive activity are more likely to result in injury and severe discomfort.
5. An attempt should be made to communicate to the trainees an understanding of the principles of conditioning, an awareness of the positive relationship to health and an encouragement to maintain a high level of proficiency after graduation.

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13. ABSTRACT DCIEM was tasked to examine the physical training aspects of the syllabus at Canadian Forces Officer Candidate School. Changes in aerobic power, body composition, muscular strength and flexibility were monitored for 2 courses, one direct entry candidates and one with commissioned from the ranks candidates. The incidence of injury and lost training times was also monitored with a special register. All candidates, especially the younger direct entry personnel arrived on course with higher than anticipated levels of fitness and consequently showed small improvements during training. There were significant changes in body composition with smaller changes in strength and flexibility. The relative influence of the scheduled physical activities and the field exercises on these changes are discussed. The incidence of sick parade attendance and consequent time lost from training is small (about 1%) and probably cannot be further reduced. Recommendations to achieve greater efficiency and utilization of time and existing resources are included.		

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KEY WORDS

physical fitness, physical training, exercise, aerobic power,
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